

Applicants: Ben-David et al.  
U.S. Serial No.: 10/719,659  
Filed: November 20, 2003  
Page 3

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Currently Amended) Apparatus comprising:

an electrode device, configured to be coupled to a site of a subject selected from the group consisting of: a vagus nerve, and an epicardial fat pad; and

a cardiac monitor, configured to detect a cardiac signal;  
and

a control unit, configured to:

drive the electrode device to apply a current to the site in respective pulse bursts in each of a plurality of cardiac cycles of the subject, and

configure the current to reduce heart rate variability of the subject below a baseline heart rate variability of the subject which corresponds to the subject's heart rate variability when the current is not applied, by initiating the applying of each burst after a delay of 30 to 200 milliseconds following an R-wave of the cardiac signal.

2. (Previously Presented) The apparatus according to claim 1, wherein the control unit is configured to configure the current to substantially not reduce a heart rate of the subject.

3. (Previously Presented) The apparatus according to claim 121, wherein the control unit is configured to configure the current to reduce the heart rate variability by at least 5% below the baseline heart rate variability during a time period

Applicants: Ben-David et al.  
U.S. Serial No.: 10/719,659  
Filed: November 20, 2003  
Page 4

in which a heart rate of the subject is not reduced responsive to the current by more than 10% below a baseline thereof.

4. (Canceled)
5. (Previously Presented) The apparatus according to claim 1, wherein the control unit is configured to drive the electrode device during exertion by the subject.
6. (Previously Presented) The apparatus according to claim 1, wherein the control unit is configured to withhold driving the electrode device when the subject is not experiencing exertion.
7. (Previously Presented) The apparatus according to claim 1, wherein the control unit is configured to configure the current to reduce a heart rate variability of the subject having a characteristic frequency between about 0.15 and about 0.4 Hz.
8. (Previously Presented) The apparatus according to claim 1, wherein the control unit is configured to configure the current to reduce a heart rate variability of the subject having a characteristic frequency between about 0.04 and about 0.15 Hz.
9. (Canceled)

Applicants: Ben-David et al.  
U.S. Serial No.: 10/719,659  
Filed: November 20, 2003  
Page 5

10. (Previously Presented) The apparatus according to claim 1, wherein the control unit is configured to drive the electrode device to apply the current in intermittent ones of a plurality of cardiac cycles of the subject.
11. (Canceled)
12. (Previously Presented) The apparatus according to claim 1, wherein the control unit is configured to drive the electrode device responsive to a circadian rhythm of the subject.
13. (Previously Presented) The apparatus according to claim 12, wherein the control unit is configured to drive the electrode device when the subject is awake.
14. (Previously Presented) The apparatus according to claim 12, wherein the control unit is configured to withhold driving the electrode device when the subject is sleeping.
15. (Previously Presented) The apparatus according to claim 1, wherein the control unit is configured to configure the current to reduce the heart rate variability by at least 10%.
16. (Previously Presented) The apparatus according to claim 15, wherein the control unit is configured to configure the current to reduce the heart rate variability by at least 50%.
17. (Previously Presented) The apparatus according to claim 1, wherein the control unit is configured to configure the

Applicants: Ben-David et al.  
U.S. Serial No.: 10/719,659  
Filed: November 20, 2003  
Page 6

current to reduce a standard deviation of a heart rate of the subject within a time window.

18. (Previously Presented) The apparatus according to claim 17, wherein the control unit is configured to configure the current to reduce a standard deviation of the heart rate of the subject within a time window longer than 10 seconds.
19. (Previously Presented) The apparatus according to claim 18, wherein the control unit is configured to configure the current to reduce by at least about 10% the standard deviation of the heart rate within the time window longer than 10 seconds.
20. (Previously Presented) The apparatus according to claim 19, wherein the control unit is configured to configure the current to reduce by at least about 50% the standard deviation of the heart rate within the time window longer than 10 seconds.
21. (Canceled)
22. (Currently Amended) The apparatus according to claim 1 [[21]], wherein the control unit is configured to configure each pulse of each of the bursts to have a pulse duration of between about 0.1 and about 4 milliseconds.
23. (Previously Presented) The apparatus according to claim 22, wherein the control unit is configured to configure each pulse

Applicants: Ben-David et al.  
U.S. Serial No.: 10/719,659  
Filed: November 20, 2003  
Page 7

of each of the bursts to have a pulse duration of between about 0.5 and about 2 milliseconds.

24. (Currently Amended) The apparatus according to claim 1 [[21]], wherein the control unit is configured to configure each of the bursts to have a pulse repetition interval of between about 2 and about 10 milliseconds.
25. (Previously Presented) The apparatus according to claim 24, wherein the control unit is configured to configure each of the bursts to have a pulse repetition interval of between about 2 and about 6 milliseconds.
- 26-27. (Canceled)
28. (Currently Amended) The apparatus according to claim 1 [[27]], wherein the control unit is configured to initiate the applying of each burst after a delay of about 50 to about 150 milliseconds following the [[an]] R-wave of the cardiac signal.
29. (Currently Amended) The apparatus according to claim 1 [[21]], wherein the control unit is configured to configure at least one of the bursts to have between about 0 and about 20 pulses.
30. (Previously Presented) The apparatus according to claim 29, wherein the control unit is configured to configure the bursts to have between about 1 and about 8 pulses during steady state operation.

Applicants: Ben-David et al.  
U.S. Serial No.: 10/719,659  
Filed: November 20, 2003  
Page 8

31-33. (Canceled)

34. (Previously Presented) The apparatus according to claim 1, wherein the control unit is configured to configure the current to reduce a heart rate of the subject.
35. (Currently Amended) The apparatus according to claim 34, wherein the cardiac monitor is comprising a sensor, configured to detect the heart rate of the subject, and to generate a heart rate signal responsive thereto, wherein the control unit is configured to configure the current to reduce the heart rate of the subject toward a target heart rate, responsively to the heart rate signal.
36. (Previously Presented) The apparatus according to claim 35, wherein the target heart rate includes a target normal heart rate within a range of normal heart rates of the subject, and wherein the control unit is configured to configure the current to reduce the heart rate of the subject toward the target normal heart rate.
37. (Canceled)
38. (Previously Presented) The apparatus according to claim 120, wherein the condition includes heart failure of the subject, and wherein the control unit is configured to configure the current to reduce the heart rate variability by at least about 10% so as to treat the heart failure.

Applicants: Ben-David et al.  
U.S. Serial No.: 10/719,659  
Filed: November 20, 2003  
Page 9

39. (Previously Presented) The apparatus according to claim 120, wherein the condition includes an occurrence of arrhythmia of the subject, and wherein the control unit is configured to configure the current to reduce the heart rate variability by at least about 10% so as to treat the occurrence of arrhythmia.
40. (Previously Presented) The apparatus according to claim 39, wherein the condition includes atrial fibrillation of the subject, and wherein the control unit is configured to configure the current to reduce the heart rate variability so as to treat the atrial fibrillation.
41. (Currently Amended) A method comprising:  
identifying a subject as being appropriate for reduction of heart rate variability of the subject below a baseline heart rate variability of the subject which corresponds to the subject's heart rate variability when parasympathetic stimulation is not applied;  
applying a current to a site of [[a]] the subject selected from the group consisting of: a vagus nerve, and an epicardial fat pad; and  
configuring the current to reduce in response to the identifying, treating a condition of the subject by reducing the heart rate variability of the subject below [[a]] the baseline heart rate variability of the subject when the current is not applied, by configuring the current.
42. (Original) The method according to claim 41, wherein applying the current comprises configuring the current to substantially not reduce a heart rate of the subject.

Applicants: Ben-David et al.  
U.S. Serial No.: 10/719,659  
Filed: November 20, 2003  
Page 10

43. (Previously Presented) The method according to claim 126, wherein configuring the current comprises configuring the current to reduce the heart rate variability by at least 5% below the baseline heart rate variability during a time period in which a heart rate of the subject is not reduced responsive to the current by more than 10% below a baseline thereof.
44. (Canceled)
45. (Previously Presented) The method according to claim 41, wherein applying the current comprises detecting exertion by the subject and applying the current during the exertion.
46. (Previously Presented) The method according to claim 41, wherein applying the current comprises:  
detecting whether the subject is experiencing exertion;  
and  
withholding applying the current when the subject is not experiencing exertion.
47. (Previously Presented) The method according to claim 41, wherein applying the current comprises configuring the current to reduce a heart rate variability of the subject having a characteristic frequency between about 0.15 and about 0.4 Hz.
48. (Previously Presented) The method according to claim 41, wherein applying the current comprises configuring the current to reduce a heart rate variability of the subject having a characteristic frequency between about 0.04 and about 0.15 Hz.

Applicants: Ben-David et al.  
U.S. Serial No.: 10/719,659  
Filed: November 20, 2003  
Page 11

49. (Canceled)

50. (Previously Presented) The method according to claim 41, wherein applying the current comprises applying the current in intermittent ones of a plurality of cardiac cycles of the subject.

51. (Canceled)

52. (Previously Presented) The method according to claim 41, wherein applying the current comprises applying the current responsive to a circadian rhythm of the subject.

53. (Original) The method according to claim 52, wherein applying the current comprises applying the current when the subject is awake.

54. (Original) The method according to claim 52, wherein applying the current comprises withholding applying the current when the subject is sleeping.

55. (Previously Presented) The method according to claim 41, wherein applying the current comprises configuring the current to reduce the heart rate variability by at least 10%.

56. (Previously Presented) The method according to claim 55, wherein applying the current comprises configuring the current to reduce the heart rate variability by at least 50%.

Applicants: Ben-David et al.  
U.S. Serial No.: 10/719,659  
Filed: November 20, 2003  
Page 12

57. (Previously Presented) The method according to claim 41, wherein applying the current comprises configuring the current to reduce a standard deviation of a heart rate of the subject within a time window.
58. (Previously Presented) The method according to claim 57, wherein applying the current comprises configuring the current to reduce a standard deviation of the heart rate of the subject within a time window longer than 10 seconds.
59. (Previously Presented) The method according to claim 58, wherein applying the current comprises configuring the current to reduce by at least about 10% the standard deviation of the heart rate within the time window longer than 10 seconds.
60. (Previously Presented) The method according to claim 59, wherein applying the current comprises configuring the current to reduce by at least about 50% the standard deviation of the heart rate within the time window longer than 10 seconds.
61. (Canceled)
62. (Currently Amended) The method according to claim 41 [[61]], wherein applying the current comprises configuring each pulse of each of the bursts to have a pulse duration of between about 0.1 and about 4 milliseconds.
63. (Original) The method according to claim 62, wherein applying the current comprises configuring each pulse of each of the

Applicants: Ben-David et al.  
U.S. Serial No.: 10/719,659  
Filed: November 20, 2003  
Page 13

bursts to have a pulse duration of between about 0.5 and about 2 milliseconds.

64. (Currently Amended) The method according to claim 41 [[61]], wherein applying the current comprises configuring each of the bursts to have a pulse repetition interval of between about 2 and about 10 milliseconds.
65. (Original) The method according to claim 64, wherein applying the current comprises configuring each of the bursts to have a pulse repetition interval of between about 2 and about 6 milliseconds.
- 66-67. (Canceled)
68. (Currently Amended) The method according to claim 41 [[66]], wherein applying the current comprises initiating the applying of each burst after a delay of about 50 to about 150 milliseconds following the [[an]] R-wave of the cardiac signal.
69. (Currently Amended) The method according to claim 41 [[61]], wherein applying the current comprises configuring at least one of the bursts to have between about 0 and about 20 pulses.
70. (Original) The method according to claim 69, wherein applying the current comprises configuring the bursts to have between about 1 and about 8 pulses during steady state operation.

Applicants: Ben-David et al.  
U.S. Serial No.: 10/719,659  
Filed: November 20, 2003  
Page 14

71-73. (Canceled)

74. (Original) The method according to claim 41, wherein applying the current comprises configuring the current to reduce a heart rate of the subject.

75. (Currently Amended) The method according to claim 74, wherein applying the current comprises detecting the heart rate of the subject, and configuring the current to reduce the heart rate of the subject toward a target heart rate, responsively to the heart rate signal.

76-77. (Canceled)

78. (Previously Presented) The method according to claim 127, wherein the condition includes heart failure of the subject, and wherein treating the condition comprises configuring the current to reduce the heart rate variability by at least about 10% so as to treat the heart failure.

79. (Previously Presented) The method according to claim 127, wherein the condition includes an occurrence of arrhythmia of the subject, and wherein treating the condition comprises configuring the current to reduce the heart rate variability by at least about 10% so as to treat the occurrence of arrhythmia.

80. (Previously Presented) The method according to claim 79, wherein the condition includes atrial fibrillation of the subject, and wherein treating the condition comprises

Applicants: Ben-David et al.  
U.S. Serial No.: 10/719,659  
Filed: November 20, 2003  
Page 15

configuring the current to reduce the heart rate variability so as to treat the atrial fibrillation.

81-118. (Canceled)

119. (Previously Presented) The apparatus according to claim 1, wherein the control unit is configured to drive the electrode device to apply the current with an amplitude of between about 2 and about 10 millamps.
120. (Previously Presented) The apparatus according to claim 1, wherein the control unit is configured to configure the current to treat a condition of the subject by reducing the heart rate variability.
121. (Previously Presented) The apparatus according to claim 1, wherein the control unit is configured to configure the current to reduce the heart rate variability by at least 5% below the baseline heart rate variability.
122. (Previously Presented) The apparatus according to claim 1, wherein the control unit is configured to configure the current to cause a prolonged reduced level of the heart rate variability.
123. (Previously Presented) The apparatus according to claim 35, wherein the control unit comprises an integral feedback controller that has inputs comprising the detected heart rate and the target heart rate, and wherein the control unit is

Applicants: Ben-David et al.  
U.S. Serial No.: 10/719,659  
Filed: November 20, 2003  
Page 16

configured to configure the current responsively to an output of the integral feedback controller.

124. (Previously Presented) The apparatus according to claim 35, wherein the target heart rate is lower than a normal average heart rate of the subject, and wherein the control unit is configured to configure the current to reduce the heart rate of the subject toward the target heart rate.
125. (Previously Presented) The method according to claim 41, wherein applying the current comprises applying the current with an amplitude of between about 2 and about 10 milliamps.
126. (Previously Presented) The method according to claim 1, wherein applying the current comprises configuring the current to reduce the heart rate variability by at least 5% below the baseline heart rate variability.
127. (Canceled)
128. (Previously Presented) The method according to claim 41, wherein configuring the current comprises configuring the current to cause a prolonged reduced level of the heart rate variability.
129. (Previously Presented) The method according to claim 75, wherein configuring the current comprises configuring the current to reduce the heart rate toward the target heart rate responsively to an output of an integral feedback controller

Applicants: Ben-David et al.  
U.S. Serial No.: 10/719,659  
Filed: November 20, 2003  
Page 17

whose inputs comprise the detected heart rate and the target heart rate.

130. (Previously Presented) The method according to claim 75, wherein the target heart rate is lower than a normal average heart rate of the subject, and wherein applying the current comprises configuring the current to reduce the heart rate of the subject toward the target heart rate.

131. (Previously Presented) The method according to claim 75, wherein the target heart rate includes a target normal heart rate within a range of normal heart rates of the subject, and wherein applying the current comprises configuring the current to reduce the heart rate of the subject toward the target normal heart rate.

132. (New) A method comprising:

detecting a cardiac signal of the subject;  
applying a current to a site of a subject in respective pulse bursts in each of a plurality of cardiac cycles of the subject, the site selected from the group consisting of: a vagus nerve, and an epicardial fat pad; and

configuring the current to reduce heart rate variability of the subject below a baseline heart rate variability of the subject which corresponds to the subject's heart rate variability when the current is not applied, by initiating the applying of each burst after a delay of 30 to 200 milliseconds following an R-wave of the cardiac signal.